

The Lynn Canal Wind Regime

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In southeast Alaska, topography has a huge impact on local weather and is responsible for numerous microclimates. The effects are nothing new or unique in that the most common, and most problematic, are all variations on the same themes that were introduced in the AWOC Winter IC 4.3 Microclimates module.

One well known and (qualitatively) easily predictable microclimate has to do with the wind regime over one of the inner channels known as Lynn Canal. This very long and narrow fjord extends 66 nm SSE from near the town of Haines to the junction with another major inner channel called Icy Strait, which is oriented east-west. To the south of this junction, Lynn Canal continues as Chatham Strait an additional 120 nm to the outer coast at Cape Ommaney at the southern tip of Baranof Island. Lynn Canal is bordered on the west by the Chilkat Mountains with multiple mountain peaks ranging from 5200 feet to 7400 feet in elevation. To the east, mountains also rise up abruptly from the shore of Lynn Canal with the terrain rising steadily up into the Juneau Ice Field. Mountain peaks near the eastern shore of Lynn Canal range from 4800 feet to 7100 feet. Southerly winds escape out of the northern end of Lynn Canal by heading northwest up the Chilkat River Valley west of Haines, or NNE through Taiya Inlet, past Skagway, and up the Skagway River Valley to White Pass.

The constraints imposed by the surrounding topography make it easy to understand why the distribution of wind directions over Lynn Canal are bi-modal, with 170 and 250 degrees being far and away the most commonly observed. What is not so readily apparent to the casual observer or even to another meteorologist not familiar with this microclimate is how strongly the topography governs the direction of the wind. In a synoptic scale set up with a low located to the south and slightly west of the long axis of Lynn Canal, the surface pressure pattern would suggest a southerly wind regime, considering both the geostrophic flow and the channeling caused by the surrounding mountains. The winds will, however, be out of the north and be blowing far stronger than the pressure gradient would suggest.

The situation is similar in the opposite sense when a strong surface low exists over northwest British Columbia or southwest Yukon; winds will be out of the north and be far stronger than the surface pressure gradient would lead one to expect. The situation can be likened to a gap flow process, except in this case, the “gap” is 60 nm long.

Local knowledge of this phenomenon as well as other similar wind microclimates resulting from the juxtaposition of the smooth, flat inner channels bordered by steep mountains has resulted two very useful and highly reliable rules of thumb. The wind direction over Lynn Canal can be determined very simply by determining whether the surface pressure gradient is northerly or southerly. The sustained wind speed over Lynn Canal can be estimated by determining the magnitude of the pressure gradient between Juneau and Skagway; 10 kts of sustained wind speed for every millibar. There are times when this particular rule of thumb is not as reliable as the one used for determining direction, such as when the near surface environment is effectively de-coupled from the winds at mountain top level – during strong surface inversions, for example. Local knowledge has also resulted in the development of a Smart Tool at WFO Juneau called “Wind from T-Pres”. Upon loading the SLP and surface wind field for the model of choice into GFE, it becomes readily apparent that even a high resolution model such as NAM-12 does not come close to capturing the details and micro-climates of the winds over southeast Alaska in either direction or speed. The “Wind from T-Pres” smart tool will correct these deficiencies of direction and speed in most cases. This is especially true for those inner channels when the pressure gradient is perpendicular to, or very nearly so, the inner channel in question.

Like any Smart Tool, “Wind from T-Pres” has its limits in terms of usefulness and appropriate applications with the wind grids. Moreover, the results must be checked closely whenever the pressure gradient is close to being parallel to the long axis of an inner channel. Due to the convoluted nature of the inner channels of southeast Alaska, this means that the results of Wind from T-Pres should always be checked in order to determine whether or not the desired result was achieved.